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(71) Applicant: **Fort James Corporation**
Richmond, Virginia 23219 (US)

(72) Inventors:
- **Connolly, Aidan William**
  Neenah, WI 54956 (US)
- **Schuh, Robert Richard**
  Kaukauna, WI 54915 (US)

(74) Representative: **Cropp, John Anthony David et al**
MATHYS & SQUIRE
100 Grays Inn Road
London, WC1X 8AL (GB)

(54) Coreless paper roll manufacturing method

(57) A method of forming coreless paper rolls from an elongated, coreless paper log includes applying moisture to the log as it is wound to form discrete bands of moistened paper separated by unmoistened log portions. After the log has been wound and the spaced bands of moisture formed on the log, the log is slid axially from a winder shaft and cut into individual coreless paper rolls. The cuts are made between the edges of the bands of moisture and the log is sawn while one band edge is located on the winder shaft.

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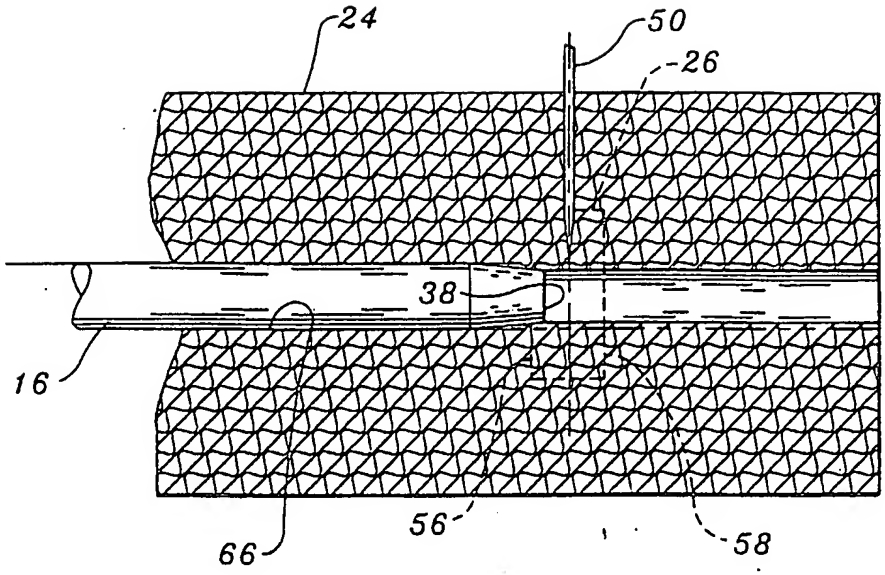

Fig. 10

Description

TECHNICAL FIELD

This invention relates to a method for forming paper rolls. More particularly, the invention is concerned with a method for forming coreless tissue rolls.

BACKGROUND ART

U.S. Patent No. 5,387,284, issued February 7, 1995, and U.S. Patent No. 5,467,936, issued November 21, 1995, disclose a system for forming coreless paper roll products. The coreless paper roll products are formed by slitting a paper web to form web segments having side edges. The web segments formed by the slitting operation are then wound about an elongated winder shaft. During winding of the paper web segments, liquid is applied to the web segments only at the side edges thereof while maintaining the web segments free of liquid between the side edges. When the separate roll products are formed they are stripped from the winder shaft.

The approach disclosed in the above-identified patents utilizing a web slitter to slit the paper web prior to formation of the individual rolls has been found to have certain drawbacks.

Employment of slitters as taught by the above-identified two patents limits production capacity. That is, speed and efficiency of the winder mechanism are compromised by use of in-line slitters wherein the web is slit into individual web portions or segments during the winding process.

In-line slitters require considerable maintenance as well as stocking of spare parts. In-line slitters also call for a significant expenditure of the operator's time to make adjustments.

Another drawback of in-line slitters as shown in the two patents referenced above is that they typically are limited as to the lengths of the roll products that can be produced thereby. Considerable time must be expended to utilize even that limited adjustment capability.

Another difficulty arising from the use of in-line slitters at the roll product winder is that of maintenance of product quality. In-line slitters can cause "ridging" at the ends of the paper rolls due to changes in alignment occurring between the slitter knives and the winding mandrel or shaft about which the rolls are wound. Variations of this type produce ragged roll edges on the rolls, often requiring their recycling or discard. Furthermore, some difficulties have been encountered in the prior art with respect to crushing of the rolls at the central openings thereof. Separate pieces of equipment and operational steps may be required to reform the central openings to make the rolls suitable for use.

U.S. Patent No. 5,271,137, issued December 21, 1993 and U.S. Patent No. 5,453,070, issued September 26, 1995, also relate to the manufacture of coreless paper roll products. More particularly, these patents disclose systems for cutting elongated coreless paper rolls or logs with a saw. However, there is no teaching or suggestion whatsoever in these patents of premoistening the log at selected locations thereon nor of cutting the log into individual rolls at such locations. As a consequence, an individual coreless roll product produced by the systems of these latter two patents will not have structure incorporated in the roll itself which will retain definition and impart stability to the roll at the central opening thereof.

DISCLOSURE OF INVENTION

The present invention relates to a method of forming coreless paper rolls preferably of tissue paper. The method is characterized by its relatively high degree of efficiency and lower expense as compared to prior art approaches. Furthermore, the method results in production of a high quality paper roll product having a well defined central opening and straight smooth sides. The roll produced by the method enables a consumer to utilize the wound tissue web comprising the roll with little or no waste. Waste is also minimized during manufacture.

The method of the present invention includes the step of transporting a paper web toward an elongated winder shaft having an outer peripheral surface and a winder shaft end.

Contact is established between the paper web and the outer peripheral surface of the elongated winder shaft.

After the step of establishing contact between the paper web and the outer peripheral surface of the elongated winder shaft, the elongated winder shaft is rotated to wind the paper web about the outer peripheral surface of the elongated winder shaft to form a unitary, elongated coreless paper log on and extending about the elongated winder shaft.

During winding of the paper web about the elongated winder shaft and during formation of the unitary, elongated coreless paper log, liquid is applied to the unitary, elongated coreless paper log at predetermined spaced locations thereon to form spaced, discrete bands of moistened paper at the predetermined space locations separated by substantially unmoistened portions of the unitary, elongated coreless paper log.

Rotation of the elongated winder shaft is stopped after the unitary, elongated coreless paper log has attained a predetermined diameter.

Also after the unitary, elongated coreless paper log has attained the predetermined diameter, the unitary, elongated coreless paper log is separated from the elongated winder shaft by relatively slidably, axially moving the elongated winder shaft and the unitary, elongated coreless paper log and passing the unitary, elongated winder shaft end through the unitary, elongated coreless paper log.

The unitary, elongated coreless paper log is cut at the predetermined spaced locations into separate segments, each separate segment comprising a coreless paper roll.

The invention will now be described with reference to one embodiment thereof and with the aid of the accompanying drawings in which:

Fig. 1 is a perspective view of representative apparatus utilized when carrying out the method of the present invention, with certain segments thereof broken away and illustrated in cross-section;

Fig. 2 is an enlarged cross sectional view taken along the line 2-2 of Fig. 1;

Fig. 3 is an enlarged perspective view in partial cross section showing a segment of the apparatus of Fig. 1 at an initial stage of operation thereof;

Fig. 4 is a view similar to Fig. 3 but illustrating a latter stage of the operation of the apparatus when practicing the method of the present invention;

Fig. 5 is a view similar to Fig. 1 but illustrating the apparatus in the condition assumed by the various structural components thereof during a latter stage of operation;

Fig. 6 is a top plan view of the apparatus shown in Fig. 1 with certain portions or segments thereof broken away for illustrative purposes;

Fig. 7 is a perspective view of a selected segment of the apparatus showing the step of removing a unitary, elongated coreless paper log from the elongated winder shaft of the apparatus;

Figs. 8 and 9 illustrate consecutive steps being carried out when sawing the log into individual roll products; and

Fig. 10 is an enlarged cross-sectional view of end segments of the log and the winder shaft, the log being sawn.

Referring now to the drawings, the method of the present invention is illustrated in accordance with one embodiment thereof being carried out on a winder machine including a frame 10 supporting a pair of trunnion rolls 12, 14. The trunnion rolls are rotatably driven by suitable conventional winder drive structure (not shown) in the directions of the arrows illustrated in Fig. 2.

A free floating elongated mandrel or winder shaft 16 having a smooth round outer peripheral surface is positioned on and supported by the outer surfaces of the trunnion rolls. The elongated winder shaft rotates when the trunnion rolls rotate due to the frictional engagement between the winder shaft and trunnion rolls.

A rider roll 18 floats on the winder shaft and is disposed above the trunnion rolls, the rider roll always bearing downwardly against the winder shaft under the influence of gravity. If desired, a mechanical form of biasing means (not shown) may be utilized to augment the downward bias imparted to the winder shaft by the rider roll.

According to the present invention, the rolls 12, 14, 18 are rotated along with elongated winder shaft 16. The lead end of a paper web 20 is transported toward the winder shaft and contact is established between the paper web and the outer peripheral surface of the winder shaft.

Rotation of the winder shaft will serve to wind the paper web about the outer peripheral surface thereof to form a unitary, elongated coreless paper log on and extending about the winder shaft. Fig. 3 illustrates an early stage of formation of such a log, identified by reference numeral 24, at which stage the log only comprises a few convolutions of the paper web material.

During winding of the paper web about the elongated winder shaft, liquid is applied to convolutions of the unitary, elongated coreless paper log being formed at predetermined spaced locations on the log. This results in formation of spaced, discrete bands 26 of moistened paper at the predetermined spaced locations on the log where liquid is applied. These bands are separated by substantially unmoistened portions of the unitary, elongated coreless paper log. Each band of moistened paper has spaced band edges adjoining the substantially unmoistened portions of the log.

In the arrangement illustrated, the liquid, which for example may suitably be merely water, is applied by nozzles 30 extending downwardly from a common header 32 extending along the length of the log and winder shaft. Water or other suitable liquid is delivered into the interior of the header from any suitable source (not shown). In the arrangement illustrated, the water is first sprayed onto the rider roll 18, with the rider roll 18 delivering the moisture to the log; however, the liquid may be applied directly to the log or through the agency of the trunnion rolls. Furthermore, any suitable means other than spray nozzles may be utilized to provide application of moisture.

According to the present invention, it is desirable that the moisture be applied only to the inner convolutions of the log, the tissue or other paper comprising the web molding itself to the shape of the shaft at the locations of the bands of moisture 26. The water or other suitable liquid will cause a breakdown in the fiber bonds of the web where moistened, it being understood that subsequent drying will re-establish the fiber bonds and cause the central opening of the log at the moistened locations to maintain a configuration generally corresponding to that of the shaft. This will promote ready entry of dispenser roll support spindles into the roll products produced.

Suitable valve means (not shown) terminates flow of liquid from the nozzles when the log has attained a predetermined diameter. This suitably may be accomplished either by employing automatic sensors to operate the valving or manually.

Fig. 4 illustrates a latter stage of the operation wherein liquid flow from the nozzles 30 has ceased. The log 24 grows until its final desired diameter is attained.

At this point rotation of the rolls and elongated winder shaft is terminated. The log is severed from the rest of the paper web 20 by any conventional cutter arrangement (not shown).

After the unitary, elongated coreless paper log 24 has attained its final predetermined diameter, the log is separated from the winder shaft by relatively slidably, axially moving the winder shaft and the log and passing the winder shaft end 38 (Fig. 5) through the log. This is accomplished, as perhaps best illustrated in Figs. 7 through 9, by exerting an end-wise force on the log 24 in the direction of winder shaft end 38. At the same time the winder shaft is held against axial movement. In the arrangement illustrated, end-wise axially directed forces are applied to the log 24 in the direction of the arrows shown in Figs. 7 through 9 by a pusher 40 suitably powered by a hydraulic or pneumatic cylinder (not shown) or other suitable arrangement.

An enlargement 44 (Fig. 7) is formed at the end of the winder shaft opposed to end 38. A bracket 46 having a vertical slot formed therein is affixed to frame 10, the slot allowing vertical movement of the winder shaft during the winding operation. The bracket cooperates with enlargement 44 to prevent axial movement of the winder shaft as the log 24 is urged therefrom by the pusher.

A cutting means such as rotary saw 50 is mounted on the winder machine frame, suitable mechanism (not shown) being utilized to move cutting means from the retracted position shown in Fig. 5, for example, to an extended position. Figs. 8 and 9 show the rotary saw at locations assumed thereby between the retracted and fully extended position.

According to the present invention the pusher 40 axially slidably moves the paper log relative to the winding shaft in uniform incremental stages during the operation of withdrawing the log from the winder shaft. The degree of relative movement in each stage corresponds to the length of the coreless paper roll to be produced. That is, the log 24 is stripped from the winder shaft 16 in incremental steps, the relative movement stopping prior to engagement of the saw blade with the log.

Such positioning is quite critical, and Figs. 8 and 10 illustrate the relative positions assumed by the log 24, winder shaft end 38, and saw blade 50 when the sawing or cutting step takes place.

As previously stated, the bands of moistened paper 26 have spaced band edges. In Fig. 10 the positioning of a band during the sawing operation is illustrated. The band 26 is depicted by dash lines and the band edges thereof are designated by reference numerals 56, 58. According to the present invention, sawing occurs between the band edges of each band of moisture. Furthermore, the sawing between the band edges of each band is accomplished while one band edge of the band being sawn is disposed about the winder shaft end 38. Also, the location where the cut is to be made by the saw is out of registry with the winder shaft end and immediately adjacent thereto. Utilizing this approach, the winder shaft end will provide support for the elongated coreless paper log and the coreless paper roll being cut therefrom at the location of cut during the cutting step. Fig. 9 illustrates one such coreless paper roll 60 which has been severed by the saw.

With further reference to Fig. 10, it will be noted that log 24 has an opening 66 extending therethrough. That portion of the opening 66 positioned on the winder shaft has a configuration corresponding to the predetermined cross-sectional shape of the winder shaft end. As the log moves off and away from the winder shaft end 38, the cross-sectional configuration of the opening 66 changes as a result of forces exerted by the wound convolutions of the log segment removed from the winder shaft. This clearly can be seen in Fig. 10 wherein the size of the opening is less at the leading end of the log which is unsupported by the winder shaft than the rest of the log supported by the winder shaft.

The opening 66 is in the general form of a truncated cone adjacent to the winder shaft end. It is here that the cut is made since the winder shaft still provides a degree of support for the paper roll at this location. Of course, after complete severing occurs, the opening of the paper roll will have a more generally uniform dimension along the full length thereof. Some puckering of the paper roll may occur at the convolutions defining the opening and such puckering is illustrated by phantom lines in Fig. 10. However, the opening of the paper roll will be well defined and readily allow for insertion of paper roll supports of a dispenser.

Claims

1. A method of forming coreless paper rolls, said method comprising:

transporting a paper web toward an elongated winder shaft having an outer peripheral surface and a winder shaft end;

establishing contact between the paper web and the outer peripheral surface of the winder shaft;

rotating the winder shaft to wind the paper web about the outer peripheral surface of the winder shaft to form a unitary, elongated coreless paper log on and extending about the elongated winder shaft;

applying liquid to convolutions of the paper log at predetermined spaced locations along the log during the winding of the web to form spaced, discrete bands of moistened paper at predetermined locations separated by substantially unmoistened portions of the log;

stopping rotation of said winder shaft after the paper log has attained a predetermined diameter;

after the paper log has attained the predeter-

mined diameter, separating the paper log from the winder shaft by effecting relative axial motion between the log and the shaft such that the winder shaft end passes through the paper log; and

cutting the paper log at the predetermined spaced locations into separate segments, each separate segment comprising a coreless paper roll.

2. A method according to Claim 1 characterised in that only inner convolutions of said unitary, elongated coreless paper log are moistened.

3. A method according to Claim 1 or Claim 2 characterised in that the relative axial motion between the log and the shaft is effected in substantially uniform incremental stages and the paper log is sawn seriatim into coreless paper rolls while passing the winder shaft through the paper log.

4. A method according to Claim 3 characterised in that the relative axial motion between the paper log and the winding shaft is terminated immediately after each of the predetermined locations is brought out of registry with the winding shaft end whereby the winding shaft end will provide support for the unitary, elongated paper log and the paper roll being cut therefrom during said cutting step to resist collapse of the elongated paper log and the paper roll being cut therefrom.

5. A method according to Claim 3 or Claim 4 characterised in that the bands of moistened paper each have spaced band edges and wherein the paper log is sawn between the band edges of each band.

6. A method according to Claim 5 characterised in that the paper log is sawn between the band edges of each band while one band edge of the band being sawn is disposed about the winder shaft end.

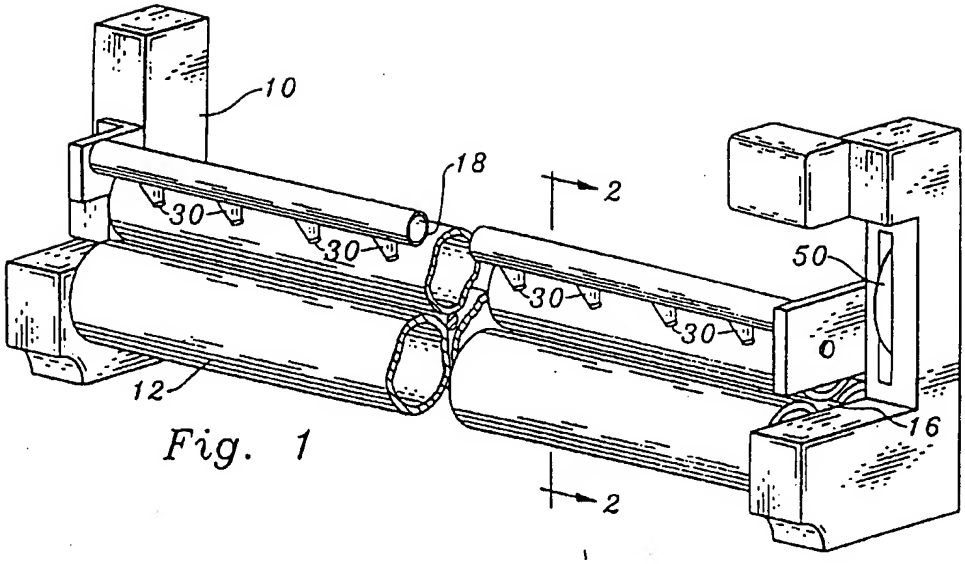

Fig. 1

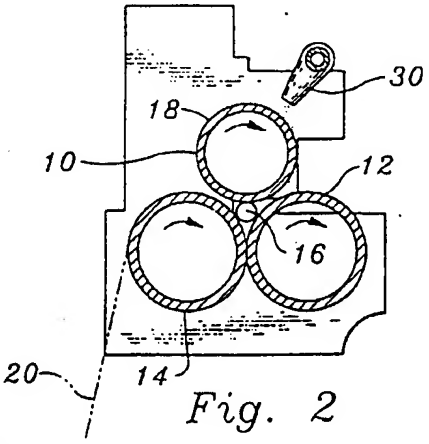

Fig. 2

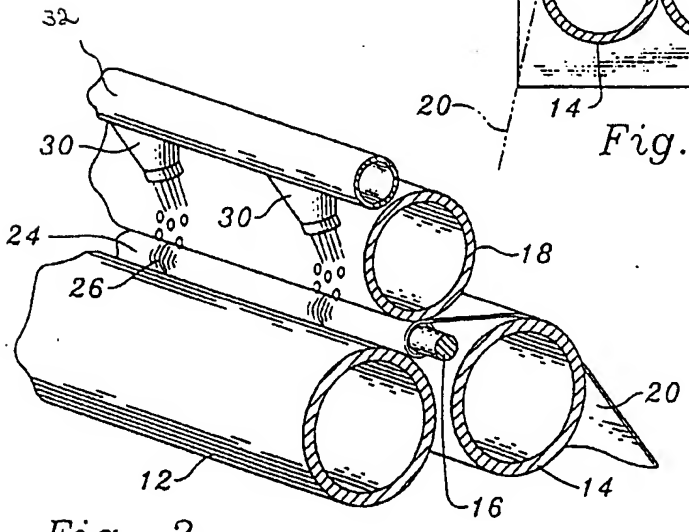

Fig. 3

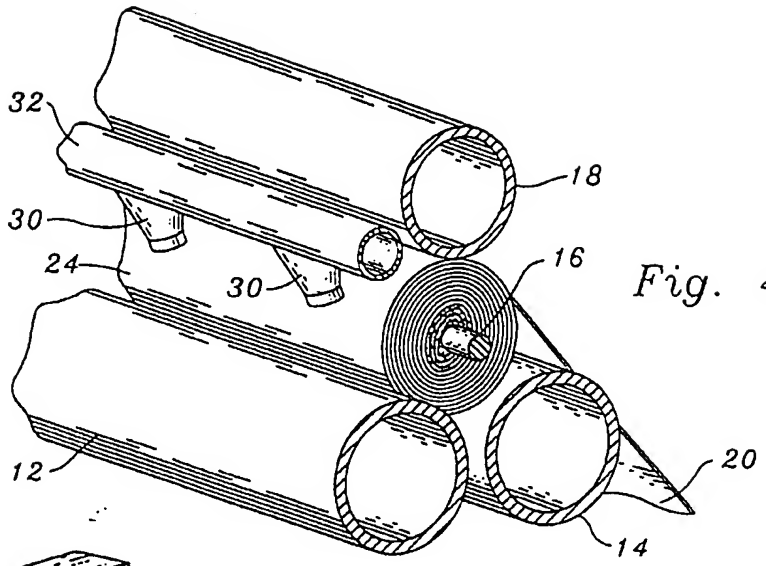

Fig. 4

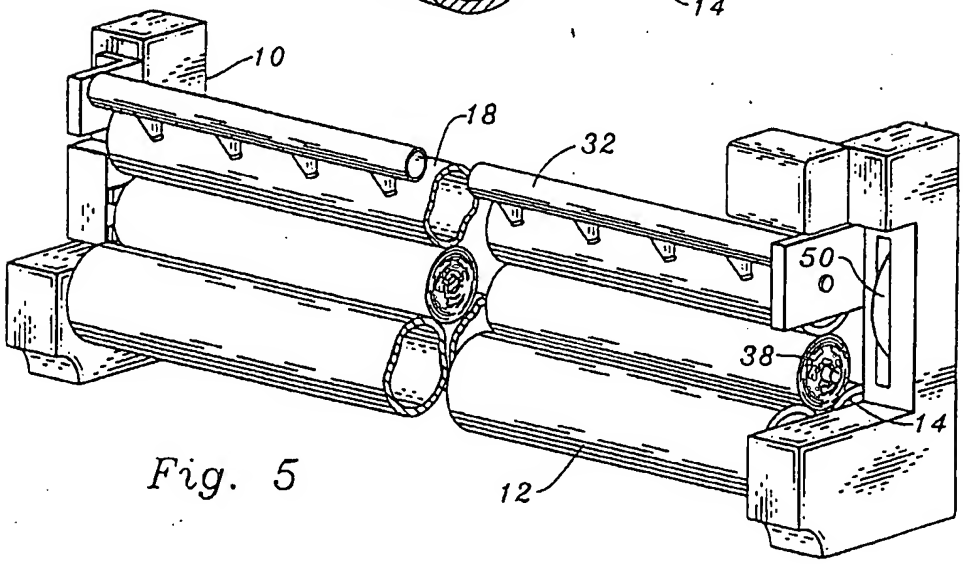

Fig. 5

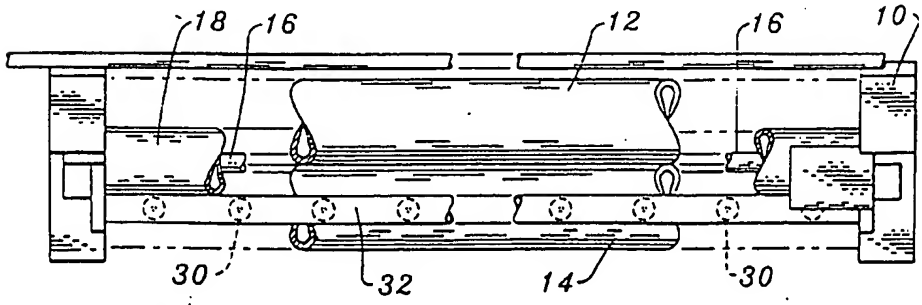

Fig. 6

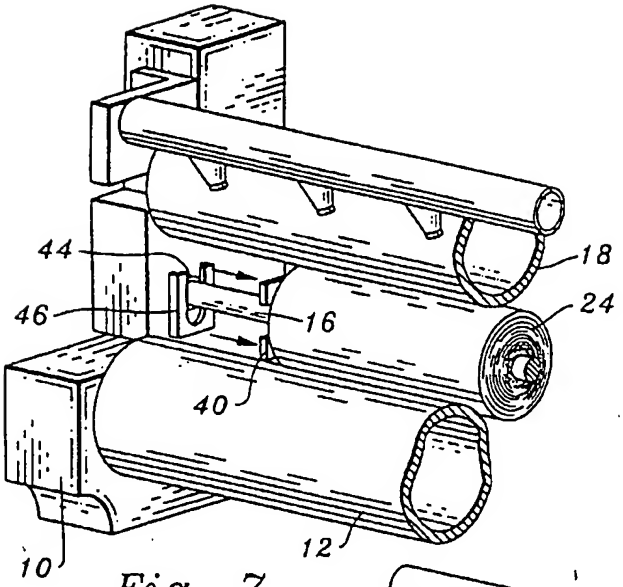

Fig. 7

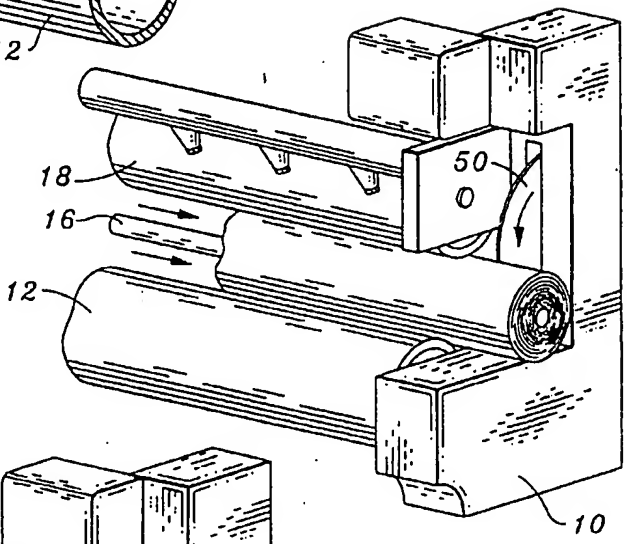

Fig. 8

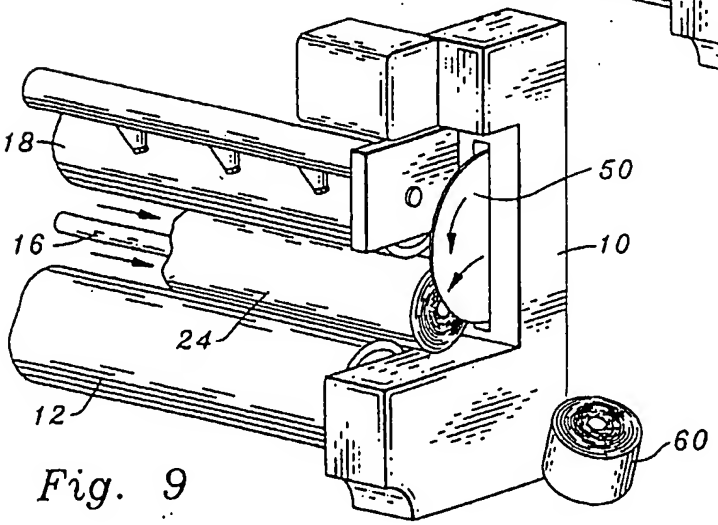

Fig. 9